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Assessment of Cardiac Oxidative Status of Diabetic Wistar Rats Exposed to Methanol Fraction of Ethanol Extract of *Dialium Guineense* Stem Bark

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ABSTRACT

The present study investigated the cardiac oxidative status of diabetic Wistar rats exposed to methanol fraction of ethanol extract of *Dialium guineense* (MEDG) stem bark. Male Wistar albino rats (n = 25, mean weight = 215 ± 15 g) were randomly assigned to five groups of 5 rats each: normal control, diabetic control, metformin, MEDG (200 mg/kg body weight, bwt) and MEDG (300 mg/kg bwt) groups. A single intraperitoneal injection of 50 mg/kg bwt STZ was used to induce diabetes mellitus in the rats. The diabetic rats were treated for 21 days with either metformin (50 mg/kg bwt) or MEDG stem bark. Activities of antioxidant enzymes such as catalase, superoxide dismutase (SOD), glutathione peroxidase (GPx) and glutathione reductase (GR) as well as molecules like glutathione (GSH), total protein (TP), malondialdehyde (MDA) and nitric oxide (NO) were measured in heart homogenate (20 %). The results showed that induction of diabetes mellitus with STZ significantly increased the fasting blood glucose (FBG) concentrations of the rats, while decreasing the activity/concentration of antioxidant enzymes/molecules ($p < 0.05$). However, treatment of the diabetic Wistar albino rats with MEDG stem bark markedly reduced the FBG concentration and body weights of rats but enhanced the activity/concentration of antioxidant enzymes/molecules in cardiac tissue ($p < 0.05$). These results indicate that MEDG has the potential to promote antioxidant defense in the heart of STZ-induced diabetic rats.

Keywords: Antioxidants; Cardiac Tissue; Glutathione; Lipid Peroxidation; Nitric Oxide; Oxidative Stress

Introduction

As a meshwork of cardiac muscle cells interconnected by contiguous cytoplasmic bridges the heart pumps blood through blood vessels of the circulatory system [1,2]. Chemical-induced cardiac injury constitutes serious health risk to humans [3-5]. Besides its hepatotoxic effect STZ can negatively impact the heart [4]. Defined as the toxicity that affects the heart, cardiotoxicity is of special interest to researchers in the field of medicine [6]. It continues to top safety concerns principally because of lack of sufficient knowledge of the underlying mechanisms [7]. Cardiotoxicity is characterized by abnormality of cardiac electrical activity and contractile dysfunction, ultimately leading to heart failure. Cardiovascular adverse effects can lead to cardiac arrhythmias [8,9]. Oxidative and nitrative stress, and formation of protein adduct are established mechanisms of chemical-induced cardiotoxicity. Protein adduct formation causes cardiac muscle cell inflammation, perturbation of calcium homeostasis, apoptosis (programmed cell death), cardiomyocyte swelling, nuclear splitting, vacuolization, and alteration in signalling pathways [10]. Reactive oxygen species (ROS) produced as a result of oxidative stress cause damage to cellular structures within vascular wall, thereby triggering several redox-sensitive transcriptional pathways, shifting the cell towards a pro-atherogenic transcriptomic profile [11].

Diabetes mellitus is a disease characterized by chronic hyperglycemia [12-15]. A number of diabetics frequently combine oral antidiabetic medications with herbal supplements. In Africa, there are more than 500 plants that are known to have medicinal properties [16]. *Dialium guineense* (Velvet Tamarind) is a medicinal plant used in folklore medicine for the treatment of infections (diarrhea, severe cough, bronchitis, wound, stomachaches, malaria fever, jaundice, ulcer and hemorrhoids) [17]. It is a tall, tropical, fruit-bearing tree, belonging to the Leguminosae family, and has small, typically grape-sized edible fruits with brown hard inedible shells. In Africa, it grows in dense forests along the southern edge of the Sahel. The plant grows naturally in West African countries, Central African Republic, and Sudan [18]. In Nigeria, it is known by different names: Icheku (Igbo), Awin (Yoruba), Tsamiyarkurm (Hausa) and Amughen (Bini) [19, 20]. The aim of this study was to investigate the cardiac oxidative status of diabetic Wistar rats exposed to MEDG stem bark.

Materials and Methods

Drugs and Chemicals

The standard antidiabetic drug, metformin, was purchased from Micronova Laboratories (India), and STZ was a product of British Drug House (BDH) Chemicals Ltd. (England). Absolute ethanol, chloroform and other solvents were obtained from Bell, Sons & Co. (England), while formaldehyde was purchased from Thermo Fisher Scientific Ltd. (USA). All the chemicals and solvents used in this study were of analytical grade.

Collection of Plant Material

The authenticity of the stem barks of D. guineense, which were obtained from Auchi, Edo State, Nigeria, was verified by Dr. Henry Akinnibosun of the Department of Plant Biology and Biotechnology, University of Benin, Benin City, Nigeria. The prepared plant specimen was deposited in the herbarium of same department (No. UBHD330).

Plant Extraction

The plant's stem bark was washed and shade-dried for 2 weeks at room temperature, and thereafter ground into powder using a blender. A portion (500 g) of powdered plant material was steeped in 5,000 mL of 100 % ethanol. The resulting extract was filtered through muslin cloth and freeze-dried with a lyophilizer. The ethanol extract was subsequently fractionated with absolute methanol [21,22].

Animals

Male Wistar albino rats (n = 25, mean weight = 215 ± 15 g) were bought from the Department of Anatomy, University of Benin, Nigeria and housed in wooden cages. They were acclimatized for fourteen days before commencement of the study and had free access to feed and water.

Experimental Design

The rats were randomly assigned to five groups (5 rats per group): normal control, diabetic control, metformin, MEDG (200 mg/kg bwt) and MEDG (300 mg/kg bwt) groups. Diabetes mellitus was induced in the rats via intraperitoneal injection of STZ at a dose of 50 mg/kg bwt. The diabetic rats were then treated with either metformin (50 mg/kg bwt) or the extract, for 21 days.

Tissue Sample Collection and Preparation

At the end of day 21 of treatment, the rats were euthanized under mild chloroform anaesthesia after an overnight fast. Their hearts were excised and used to prepare 20 % tissue homogenate. The homogenate was centrifuged at 2000 rpm for 10 min to obtain clear supernatant.

Biochemical Analyses

The activities of catalase, SOD and GPx were determined [23-25]. cardiac levels of TP, MDA, GSH, and NO were also measured [26-29]. The activity of GR was determined using a previously described method [30].

Data Analysis

Data are presented as mean ± SEM (n = 5). Statistical analysis was performed using SPSS version 21. Statistical differences between means were compared using Duncan multiple range test. Statistical significance was assumed at $p < 0.05$.

Results

Effect of MEDG Stem Bark on Weight and Blood Glucose of Rats

Induction of diabetes mellitus with STZ significantly increased the blood glucose concentrations of the rats ($p < 0.05$). However, treatment of the diabetic rats with MEDG stem bark markedly reduced the FBG concentration and body weights of rats ($p<0.05$) (Table 1 and Figure 1). Data are weight and FBG parameters and are expressed as mean ± SEM (n = 5).

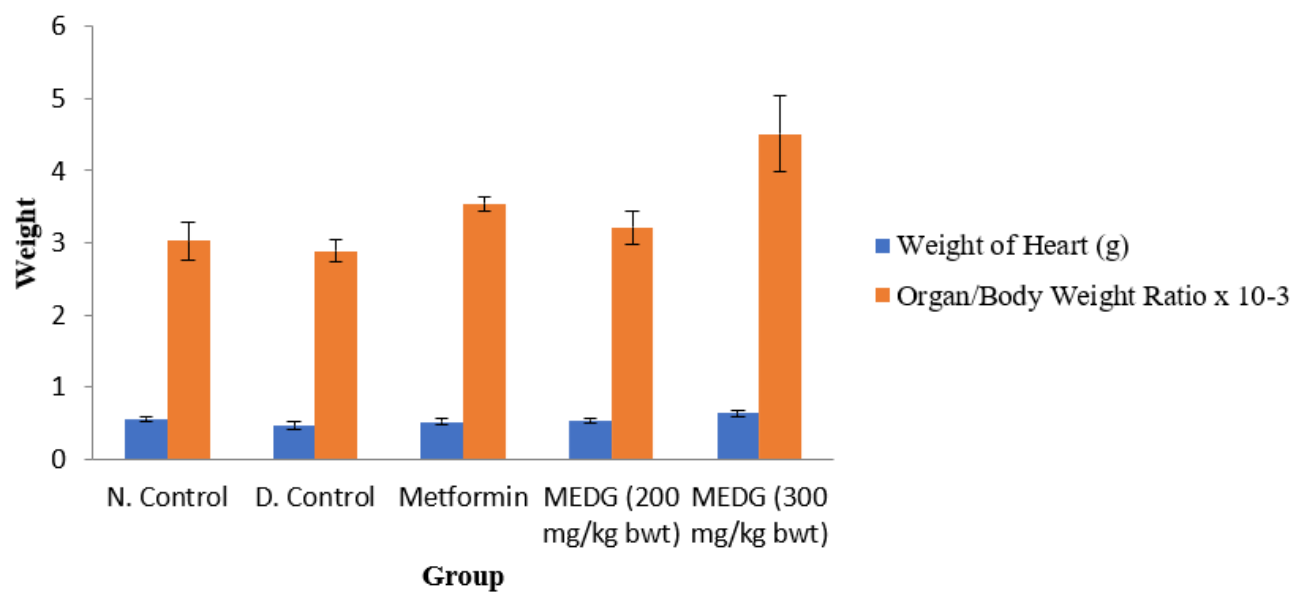

Figure 1: Comparison of Organ and Relative Organ Weights.

Table 1: Weight and Blood Glucose Parameters.

Group	Weight Change (g)	Weight Change (%)	FBG (mg/dL)	Glycemic Change (mg/dL)	Glycemic Change (%)
Normal Control	-	-	-	-	-
Diabetic Control	-	-	> 800	-	-
Metformin	20.35	12.16	> 800	399	49.88
MEDG (200 mg/kg bwt)	16	11.19	427	311	71.61
MEDG (300 mg/kg bwt)	27	15.68	467.67	394.33	78.19

Cardiac Oxidative Status of Diabetic Rats

Induction of diabetes mellitus with STZ markedly reduced the activities of the markers of oxidative stress, % GSH, and % NO in cardiac tissue ($p < 0.05$). However, treatment of diabetic Wistar albino rats with MEDG stem bark significantly increased the activities of antioxidant enzymes and other parameters measured ($p < 0.05$; Figures 2-4).

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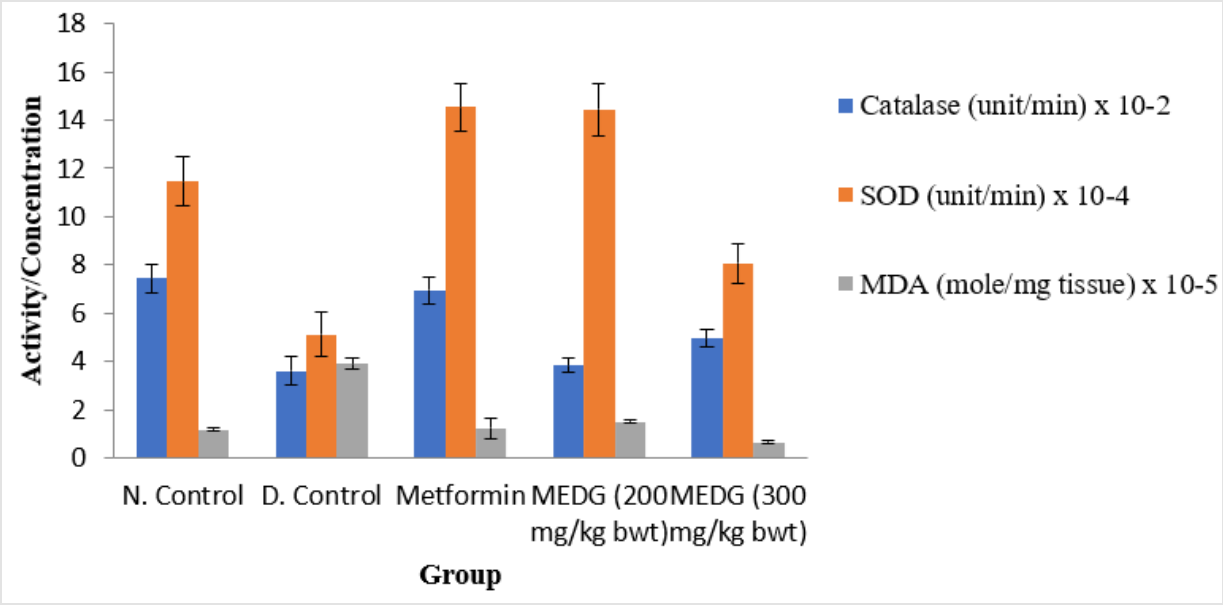

Figure 2: Effect of MEDG Stem Bark on Oxidative Status in Cardiac Tissue.

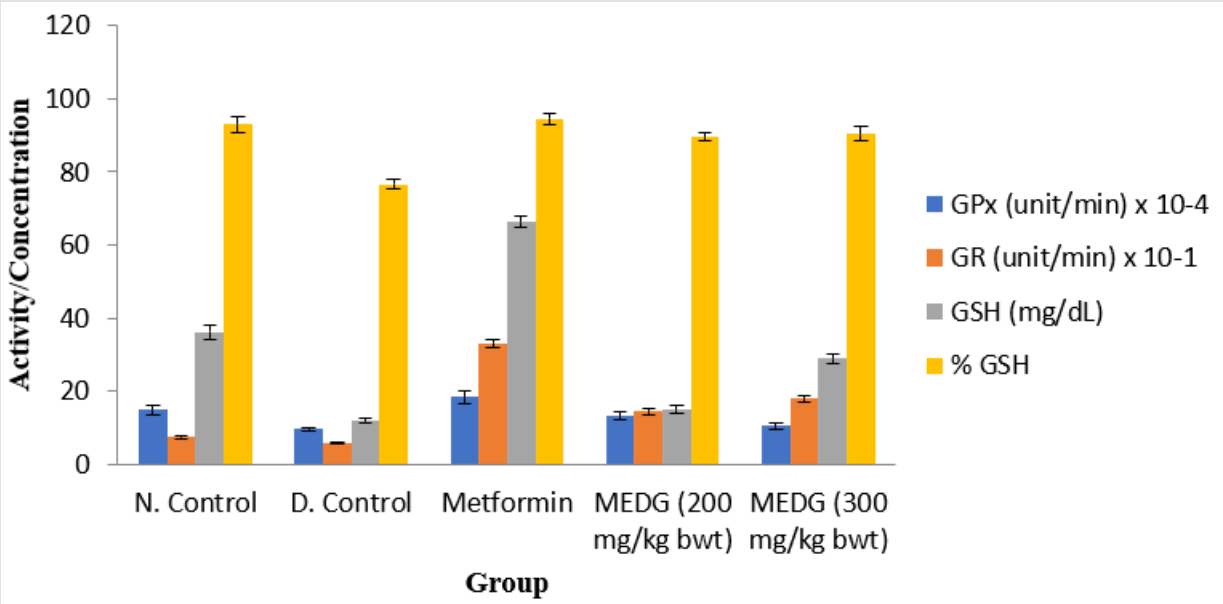

Figure 3: Effect of MEDG Stem Bark on Glutathione Enzyme System.

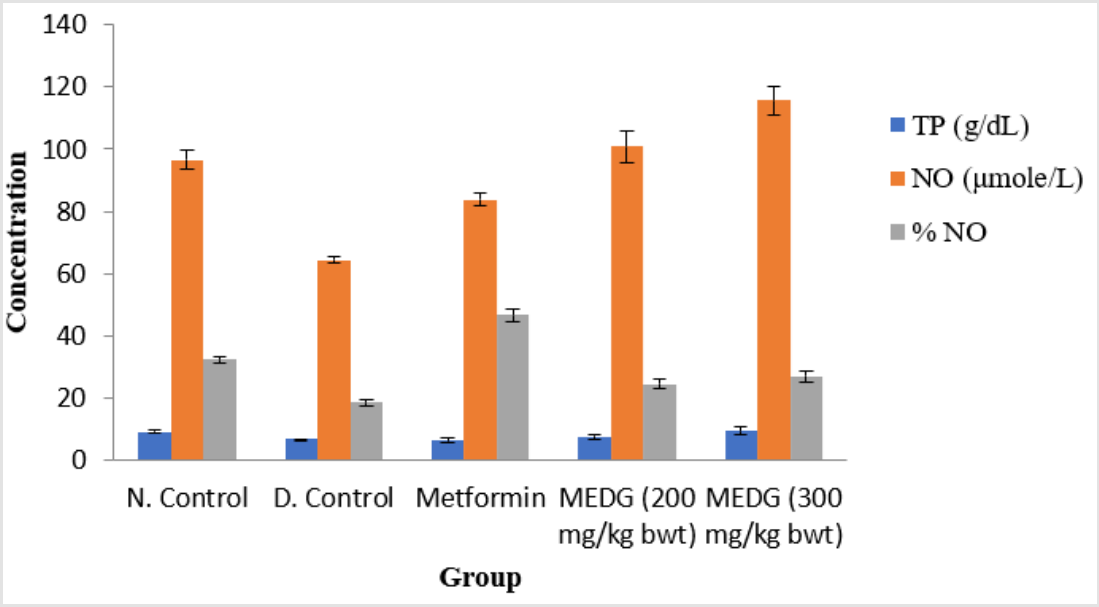

Figure 4: Effect of MEDG Stem Bark on Hepatic TP and NO Levels.

Discussion

Diabetes mellitus refers to a group of metabolic disorders characterized by a state of chronic hyperglycemia due to defects in insulin secretion, insulin action or both [31]. Over time, elevated blood glucose leads to serious damage to the heart, blood vessels, eyes, kidneys and nerves. This metabolic disorder is often described as "a silent killer" since it may be asymptomatic at onset. Therefore, the disease usually goes undiagnosed until major complications arise. Diabetes mellitus is associated with reduced life expectancy, significant morbidity as well as diminished quality of life [32-34]. It has been reported that 10 % of global health expenditure is spent on the disease annually [35,36]. There is profound reason to suggest that this figure might increase in the coming years giving the myriads of complications that result from diabetes mellitus. Oxidative stress has a mediatory role in the pathogenesis of diabetes mellitus and its related complications via promotion of free radicals production and impairment of antioxidant defense systems [36]. This study investigated the cardiac oxidative status of diabetic Wistar rats exposed to MEDG stem bark. In this study, albino rats of Wistar strain were used, since they are a well-known animal model. The results showed that diabetic rats' heart measurements were much worse than those of the normal control, which suggests that diabetic cardiomyopathy was present.

Also, the loss of aorta's ability to relax when NO is present shows that endothelial dysfunction also occurred. Compared to normal control rats, there were also more signs of oxidative stress, and inflammation. These symptoms of diabetes mellitus are well-known and are considered to be some of the main causes of the major complications. Diabetes mellitus tends to damage cell membrane, thereby enhancing the production of ROS [12,13]. Studies have demonstrated that diabetic patients experience increased oxidative and nitrosative stress, which can negatively affect the heart or arteries. In this study, induction of diabetes mellitus with STZ markedly reduced the activities of the markers of oxidative stress, % GSH, and % NO in cardiac tissue. However, treatment of diabetic Wistar rats with MEDG stem bark significantly increased the activities of antioxidant enzymes and other parameters measured. It is likely that in the myocardium STZ aggravated oxidative stress process by suppressing the expression of SOD, catalase, and GPx.

These results are consistent with those of previous studies [37-46]. The results suggest that STZ-induced diabetes mellitus promotes increased production of ROS, while suppressing the synthesis/activity of antioxidant enzymes/molecules in myocardial tissue. The MEDG stem bark may contain compounds that exert anti-hyperglycemic effects as well as oxidative stress-reducing properties in STZ-induced diabetic rats. Containing important phytochemicals, the medicinal plant has been demonstrated to exhibit a number of biological/pharmacological effects [47-83].

Conclusion

According to the findings of this study, methanol fraction of the ethanol extract of *Dialium guineense* stem bark is able to alter the oxidative status of the hearts of diabetic rats. The findings have given credence to the use of *Dialium guineense* in Traditional Medicine for the treatment of diabetes mellitus. However, additional work is required to ascertain its mode of action and determine whether or not it is harmful in the long-term.

References

1. J M Benson, B M Tibbetts, K D Thrall, D L Springer (2001) Uptake, tissue distribution, and fate of inhaled carbon tetrachloride: comparison of rat, mouse, and hamster. Inhal Toxicol 13: 207-217.
2. MacDonald M (2009) Your Body: The Missing Manual. Sebastopol, CA: Pogue Press, pp. 40.
3. Christian Cadeddu Dessalvi , Martino Deidda, Donato Mele, Pier P Bassareo, Roberta Esposito, et al. (2018) Chemotherapy-induced cardiotoxicity: new insights into mechanisms, monitoring, and prevention. J Cardiovascu Med 19(7): 315-323.
4. Abu OD, Umar AB, Adekanle E (2022) Cardiotoxic Effect of Aqueous Extract of *Dialium guineense* Stem Bark in Wistar Rats. East African Scholars. Journal of Agriculture and Life Sciences 5(9): 167-172.
5. Abu OD, Odagwe UB, Ojo AU (2022) Cardiotoxicity of Ethanol Extract of *Dialium guineense* Stem Bark in Rats. World Journal of Pharmaceutical and Life Sciences 8(11): 34-39.
6. Colombo A, Meroni CA, Cipolla CM, Cardinale D (2013) Managing cardiotoxicity of chemotherapy. Curr Treat Options Cardiovasc Med 15(4): 410-424.
7. Lipshultz SE, Diamond MB, Franco VI, Aggarwal S, Leger K, et al. (2014) Managing chemotherapy-related cardiotoxicity in survivors of childhood cancers. Paediatric Drugs 16(5): 373-389.
8. McGowan JV, Chung R, Maulik A, Piotrowska I, Walker JM, et al. (2017) Anthracycline chemotherapy and cardiotoxicity. Cardiovascular Drugs and Therapy 31(1): 63-75.
9. Zoltán V Varga, Peter Ferdinandy, Lucas Liaudet, Pál Pacher (2015) Drug-induced mitochondrial dysfunction and cardiotoxicity. American Journal of Heart and Circulatory Physiology 309(9): H1453-H1467.
10. Ashif Iqubal, Mohammad Kashif Iqubal, Sumit Sharma, Mohd Asif Ansari, Abul Kalam Najmi, et al. (2019) Molecular mechanism involved in cyclophosphamide-induced cardiotoxicity: old drug with a new vision. Life Sci 218: 112-131.
11. Liao F, Andalibi A, Qiao JH, Allayee H, Fogelman AM, et al. (1994) "Genetic evidence for a common pathway mediating oxidative stress, inflammatory gene induction, and aortic fatty streak formation in mice." Journal of Clinical Investigation 94: 877-884.
12. OD Oshan Abu, KE Imafidon, O Obayuwana (2020) Ethanol leaf extract of Anacardium occidentale ameliorates alloxan-induced changes on blood glucose level and lipid profile of Wistar rats. IAR Journal of Medical Sciences 1(5): 257-262.
13. O Obayuwana, KE Imafidon, OD Abu (2020) Phytochemical and proximate composition of leaves of Anacardium occidentale. IAR Journal of Agriculture Research and Life Sciences 1(5): 139-142.
14. Abu OD, Imafidon KE, Obayuwana O (2020) Effect of aqueous extract of Anacardium occidentale leaves on blood glucose level and lipid profile of diabetic rats. Global Scientific Journal 8(10): 977- 987.
15. Okpiabhele AO, Nwanze EAC, Abu OD (2018) Therapeutic Potential of Virgin Coconut Oil in Ameliorating Diabetes Mellitus and Hepatotoxicity Using Rattus Norvegicus as Case Study. Asian Journal of Biological Sciences 11(3): 138-144.
16. Ebhohon SO, Ibeh RC, Ejiofor UE, Abu OD, Osegenna SC (2019) Hepato- and nephro-protective effects of methanol extract of Citrullus lanatus rind in Wistar rats fed with used motor engine oil contaminated feed. FUDMA Journal of Sciences 3(4): 246-250.
17. Joanne Bero, Habib Ganfon, Marie-Caroline Jonville, Michel Frédérich, Fernand Gbaguidi, et al. (2009) *In vitro* antiplasmodial activity of plants used in Benin in traditional medicine to treat malaria. Journal of Ethnopharmacology 122(3): 439-444.
18. Kar A (2007) Pharmacognosy and Pharmaco-biotechnology (Revised-Expanded Second Edition). New Age International Limited Publishers, New Delhi, pp. 332-600.
19. Abu OD, Onoagbe IO, Obahiagbon O (2020) Qualitative phytochemical screening and proximate analysis of *Dialium guineense* stem bark. IAR Journal of Agriculture Research and Life Sciences 1(4): 108-112.
20. Abu OD, Imafidon KE, Iribhogbe ME (2015) Biochemical effect of aqueous leaf extracts of *Icacina trichanta Oliv* on urea, creatinine and kidney oxidative status in CCl4-induced Wistar rats. Nigerian Journal of Life Sciences 5(1): 85-89.
21. Abu OD, Aleogho BM, Omoregie FO (2019) Aqueous leaf extract of *Icacina trichanta Oliv.* improves lipid profile and CCl4 - induced histological changes in the liver and kidney of Wistar rats. Asian Journal of Research in Biochemistry 4(1): 1-11.
22. Abu OD, Imafidon KE, Obayuwana HO, Okwudiri NB (2017) Hepatotoxic effect of methanol extract of *citrullus lanatus* seeds in Wistar albino rats. Journal of the Nigerian Society of Experimental Biology 17(4): 159-163.
23. G Cohen, D Dembiec, J Marcus (1970) Measurement of catalase activity in tissue extracts. Analytic Biochemistry 34: 30-38.
24. H P Misra, I Fridovich (1972) The role of superoxide anions in the auto oxidation of epinephrine and a single assay for superoxide dismutase. J Biol Chem 247: 3170-3175.
25. J T Rotruck, A L Pope, H E Ganther, A B Swanson, D G Hafeman, et al. (1973) Selenium biochemical role as a component of glutathione peroxidase. Science 179: 588-590.
26. Henry RJ, Sobel C, Beckman S (1957) Determination of serum protein by the Biuret reaction. Anal Chem 92(149): 1-5.
27. Ellman GL (1959) Tissue sulphydryl groups. Archive of Biochemistry and Biophysics 82(1): 70-77.
28. J M Gutteridge, S Wilkins (1982) Cancer dependent hydroxyl radical damage to ascorbic acid. Formation of thiobarbituric acid reactive product. FEBS Lett 137: 327-340.
29. L Marcocci, L Packer, M T Droy-Lefaix, A Sekaki, M Gardès-Albert (1994). Antioxidant action of Ginkgo biloba extract EGb 761. Methods in Enzymology 234: 462-475.
30. Abu OD, Ikponmwosa-Eweka O (2022) Evaluation of the Potential of Total saponins and Tannins of *Dialium guineense* Stem Bark in the Amelioration of Carbon Tetrachloride-Induced Renal Oxidative Stress. SAU Science-Tech. Journal 7(1): 42-50.
31. (2019) International Diabetes Federation (IDF) (2019) Diabetes Atlas (9th Edn.).,. International Diabetes Federation: Brussels, Belgium.
32. R D Abbott, F N Brand, W B Kannel (1990) Epidemiology of some Peripheral Arterial Findings in Diabetic Men and Women- Experiences from the Framingham Study. Am J Med 88: 376-381.
33. A Barceló, S Rajpathak (2001) Incidence and prevalence of diabetes mellitus in the Americas. Rev Panam Salud Publica 10(5): 300-308.
34. N H Cho, J E Shaw, S Karuranga, Y Huang, J D da Rocha Fernandes, et al. (2018) IDF Diabetes Atlas: Global estimates of diabetes prevalence for 2017 and projections for 2045. Diabetes Research and Clinical Practice 138: 271-281.
35. (2000) International Diabetes Federation (IDF) (2000) Diabetes Atlas (1st Edn.)., International Diabetes Federation: Brussels, Belgium.

36. (2017) International Diabetes Federation (IDF) (2017) Diabetes Atlas (8th Edn.).,. International Diabetes Federation: Brussels, Belgium.

37. Abu OD, Awhin EP, Ifekwe JC (2023) Liver Function Status of Diabetic Wistar Rats Treated with Ethanol Extract of *Cucumis sativus* Fruit. Biomedical Journal of Scientific and Technical Research 51(2): 42440-42445.

38. Abu OD, Alegun O, Ifekwe JC (2023) Renal Oxidative Status in Diabetic Wistar Rats Administered Methanol Fraction of Ethanol Extract of *Dialium guineense.* Medical and Clinical Case Reports Journal 1(1): 1-13.

39. Abu OD, Ohikhuare F, Ezike TV (2023) *In vitro* Antioxidant Activity of Aqueous and Ethanol Extracts of *Cucumis sativus*. Journal of Clinical Epidemiology and Public Health 01(03): 1-6.

40. Abu OD, Avenbuan SE, Osarhenomase EG (2023) Renal Oxidative Status in Diabetic Wistar Rats Administered Ethanol Extract of *Cucumis sativus* Whole Fruit. Int J of Clinical Studies and Medical Case Reports 30(1): 1-4

41. Abu OD, Awhin EP, Ozedu ME (2023) Evaluation of Cardiovascular Disease Risk Factors in Diabetic Rats Administered Ethanol Extract of *Cucumis sativus* Fruit. African Journal of Health, Safety and Environment 4(1): 108-117.

42. Abu OD, Awhin EP, Iyare HE (2023) Assessment of Renal Function in Diabetic Wistar Rats Treated with Ethanol Extract of *Cucumis sativus*. African Journal of Health, Safety and Environment 4(1): 101-107.

43. Abu OD, Awhin EP, Ifekwe JC (2023) Liver Function Status of Diabetic Wistar Rats Treated with Ethanol Extract of *Cucumis sativus* Fruit. Biomedical Journal of Scientific and Technical Research 51(2): 42440-42445.

44. Abu OD, Osime EC, Ngedaa OS (2023) Cardiac Oxidative Status in Diabetic Wistar Rats Exposed to Ethanol Extract of *Cucumis sativus* Fruit. J Diagnostics and Case Reports 4(2): 1-5.

45. Abu OD, Ojo I, Awhin EP (2023) Protective Property of Ethanol Extract of C. sativus on STZ-Induced Diabetic Rat Pancreas. Biomedical Journal of Scientific and Technical Research 52(2): 43613-43618.

46. Abu OD, Obaze GE, Egili S, Idehen IO (2023) Ethanol Extract of C. sativus Modulates the Activity of Glucose 6-phosphatase/ Aminotransferases and Levels of Lipids in Tissues of STZ-Induced Diabetic Rats. Biomedical Journal of Scientific and Technical Research 53(4): 44989-44994.

47. Abu OD, Onoagbe IO, Obahiagbon O (2020) Alpha amylase and alpha glucosidase inhibitory activities of extracts of *Dialium guineense* stem bark. International Journal of Clinical Biology and Biochemistry 2(1): 7-10.

48. Abu OD, Onoagbe IO, Osemwenoyenmwen O (2020) Alpha amylase and alpha glucosidase inhibitory activities of isolated total saponins and tannins of *Dialium guineense* stem bark. Journal of Cellular and Molecular Biology Research 1(2): 1-3.

49. Abu OD, Onoagbe IO, Obahiagbon O (2020) *In Vitro* Antioxidant Activities of Isolated Total Saponins and Tannins of *Dialium Guineense* Stem Bark. IAR Journal of Medical Sciences 1(4): 193-199.

50. Abu OD, Onoagbe IO, Obahiagbon O (2020) Vitamin contents of extracts of *Dialium guineense* stem bark. Biomed J Sci and Tech Res 30(2): 23263-23267.

51. Abu OD, Onoagbe IO, Obahiagbon O (2020) Analyses of metal and amino acid compositions of aqueous and ethanol stem bark extracts of *Dialium guineense*. Journal of Biogeneric Science and Research 6(4): 1-3.

52. Abu OD, Onoagbe IO, Obahiagbon O (2020) Phenolic contents of extracts of *Dialium guineense* stem bark. American Journal of Sciences and Engineering Research 3(4): 92-96.

53. Abu OD, Onoagbe IO (2021) Acute toxicity of aqueous and ethanol extracts of *Dialium guineense* stem bark. Journal of Bioinnovation 10(2): 427-432.

54. Abu OD, Adeogun EF, Ebhohon SO (2019) Oral LD50 of total saponins and tannins isolated from *Dialium guineense* stem bark. European Journal of Experimental Biology 9(2): 11-13.

55. Abu OD, Onoagbe IO, Ojo I (2021) Determination of effective dose for ethanol extract of *Dialium guineense* stem bark. Journal of Medical Research and Case Reports 3(2): 1-4.

56. Abu OD, Ikponmwosa-Eweka O (2022) Potential of Extracts of Dialium guineense Stem Bark in the Mitigation of Carbon Tetrachloride-induced Renal Oxidative Stress. BIU Journal of Basic and Applied Sciences 7(1): 62-69.

57. Abu OD, Ikponmwosa-Eweka O (2022) Potential of Total Saponins and Tannins Isolated from the stem bark of *Dialium guineense* in the Amelioration of Kidney Dysfunction Caused by CCl4. Journal of Basic and Applied Medical Sciences 2(1): 1-6.

58. Abu OD, Onoagbe IO, Ojo I (2022) Dose response of total saponins isolated from the stem bark of *Dialium guineense*. Journal of Advances in Plant Biology 1(4): 1-6.

59. Abu OD, Onoagbe IO, Ojo I (2021) Graded and quantal dose response of total tannins isolated from the stem bark of *Dialium guineense*. Advanced Research Journal of Medicine and Clinical Science 08(10): 699-703.

60. Abu OD, Onoagbe IO, Ojo I (2022) Dose response study of aqueous extract of *Dialium guineense* stem bark. American Journal of Biomedical Science and Research 15(2): 250-252.

61. Abu OD, Imafidon KE, Obayuwana HO (2021) Nephrotoxic and *in vivo* antioxidant effects of *citrullus lanatus* seed extract. Biomedical Journal of Science and Technical Research 33(5): 26281-26286.

62. Abu OD, Imafidon KE, Obayuwana HO, Onodje S (2020) Quantitative phytochemical evaluation and phenolic contents of extracts of Citrullus lanatus seed. Int J Bioorg Chem Mol Biol 7(1): 31-35.

63. Abu OD, Ngedaa OS,Osarhenomase EG (2022) Effect of Extracts of *Dialium guineense* Stem Bark on Lipid peroxidation Index and Histological Changes in Kidneys of Normal Rats. Forensic Medicine 4(2): 23-29.

64. Abu OD, Onoagbe IO, Ekugum E (2022) Nephrotoxic Evaluation of Aqueous Stem Bark Extract of *Dialium guineense* in Normal Wistar Rats. Journal of Pharmaceutical and Bio-Medical Sciences 2(9): 353-357.

65. Abu OD, Onoagbe IO, Ohikhuare F (2022) Nephrotoxic Evaluation of Ethanol Stem Bark Extract of *Dialium guineense* in Normal Wistar Rats. International Journal of Forensic Medicine 4(2): 19-22.

66. Abu OD, Umar AB, Eiremiokhae CO (2022) Investigation of the Cardioprotective Capacity of Aqueous Extract of *Icacina trichanta* Leaves in Rats Exposed to CCl4. Journal of Genetics and Cell Biology 6(1): 322-328.

67. Abu OD, Onoagbe IO, Ojo I (2022) Hepatotoxicity of Aqueous Extract of *Dialium guineense* Stem Bark. Journal of Pharmacology and Toxicology.

68. Abu OD, Onoagbe IO, Ekugum E (2022) Hepatotoxicity of Graded Doses of Ethanol Extract of *Dialium guineense* Stem Bark in Wistar Rats. Journal of Pharmaceutical and Bio-Medical Sciences 2(9): 347-352.

69. Abu OD, Ezike TV, Ajuwa OI (2022) Cardioprotective property of extracts of *Dialium guineense* stem bark in rats exposed to CCl4. American Journal of Biomedical Science and Research 2022: 689-693.

70. Abu OD, Umar AB, Ajuwa OI (2022) Protective Property of Total Saponins and Tannins of *Dialium guineense* Stem Bark in CCl4-Induced Cardiotoxicity in Rats. World Journal of Genetics and Molecular Biology 1(1): 1-6.

71. Abu OD, Orobator ON, Momodu IB (2022) Investigation of the Hepatoprotective Effect of Extracts of *Dialium guineense* Stem Bark in Wistar Rats Exposed to CCl4. Journal of Clinical Gastroenterology and Hepatology 4(2): 123-126.

72. Abu OD, Orobator ON, Momodu IB (2022) Evaluation of the Effect of Total Saponins and Tannins Isolated from *Dialium guineense* Stem Bark on CCl4 - Induced Hepatotoxicity in Wistar Rats. Global Journal of Medical and Clinical Case Reports 9(3): 035-038.

73. Abu OD, Eromosele AI, Osarhenomase EG (2022) Effect of Extracts of *Dialium guineense* Stem Bark on Lipid Profile and CCl4- Induced Histological Changes in Liver of Wistar Rats. International Journal of Lipids 1(1): 22-27.

74. Abu OD, Omage JI, Ogbebor EO (2022) Effect of Total Saponins and Tannins Isolated from the Stem Bark of *Dialium guineense* on Lipid Profile and CCl4- Induced Histological Changes in Liver of Wistar Rats. Journal of Medicine and Biology 3(2): 1-9.

75. Abu OD, Iyare HE, Ogboi KU (2022) Cardiac Oxidative Status in CCl4-Exposed Rats Treated with Extracts of *Dialium guineense* Stem Bark. Global Journal of Scientific Frontier Research 22(01): 1-6.

76. Abu OD, Okuo AV, Osemwota OF (2022) Extracts of *Dialium guineense* Stem Bark Ameliorates CCl4-induced Oxidative Stress in Liver of Wistar Rats. Biomedical Journal of Scientific and Technical Research 46(2): 37297-37301.

77. Abu OD, Okuo AV, Osemwota OF (2022) Total Saponins and Tannins of *Dialium guineense* Stem Bark Protect Against CCl4-induced Oxidative Stress in Rats Liver. International Journal of Medical and Clinical Case Reports 1(1): 15-20.

78. Abu OD, Ogbebor EO, Omage JI (2022) Effect of Extracts of *Dialium guineense* Stem Bark on Oxidative Status in Rats Exposed to CCl4. Journal of Clinical Gastroenterology and Hepatology 4(3): 124-127.

79. Abu OD, Iyare HE, Ogboi KU (2022) Antioxidant Property of Total Saponins and Tannins of *Dialium guineense* Stem Bark in Rats Hearts Exposed to CCl4. Journal of Clinical Epidemiology and Toxicology 3(3): 1-4.

80. Abu OD, Ojo I, Ezike TV (2023) Methanol Fraction of Ethanol Extract of *Dialium guineense* Stem Bark Mitigates STZ-Induced Oxidative Stress in Rat Liver. Biomedical Journal of Scientific and Technical Research 51(2): 42594-42600.

81. Abu OD, Awhin EP, Ohikhuare F (2023) Effect of Methanol Fraction of Ethanol Extract of *Dialium guineense* Stem Bark on Cardiovascular Disease Risk Factors in Diabetic Rats. Journal of Biology and Medicine 4(1): 128.

82. Abu OD, Awhin EP, Iyare HE (2023) Investigation of Renal Function in Diabetic Rats Treated with Methanol Fraction of Ethanol Extract of *Dialium guineense* (MEDG) Stem Bark. Journal of Urology and Nephrology Studies 4(4): 513-518.

83. Abu OD, Okuo AV, Egili S, Idehen IO (2023) Methanol Fraction of Ethanol Extract of *Dialium guineense* Stem Bark May Alter the Activity of Glucose 6-phosphatase/Aminotransferases and Levels of Lipids in Tissues of Diabetic Wistar Rats. International Journal of Research and Scientific Innovation.

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